

Grade 3 Science

Unit 1: Investigating Forces

10 lessons and a unit quiz. Use this pack with the **Investigating Forces Student Reader** (print it, or download it once from the course) to teach the whole unit without the internet.

What is in this pack

- A lesson plan for each chapter: the Big Question, words to know, which pages to read, questions to talk over and the activity pages.
- The unit quiz, ready to print.
- Answers for the teacher at the back: every discussion question and the quiz key.

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Lesson schedule

Two or three lessons a week, about 30 minutes each. Tick each one off as you go.

	Lesson	Reader pages	Activity pages
☐	Lesson 1: Pushes, Pulls, and Motion	—	AP 1.1
☐	Lesson 2: A Force Is a Push or a Pull	PDF pages 7–12	AP 2.1
☐	Lesson 3: Investigating Forces	—	AP 3.1, AP 3.2
☐	Lesson 4: Investigating Friction	—	AP 4.1
☐	Lesson 5: Friction Is a Force	PDF pages 13–18	AP 5.1, AP 5.2
☐	Lesson 6: Predicting Patterns of Motion	PDF pages 19–24	AP 6.1
☐	Lesson 7: Investigating Magnets	—	AP 7.1
☐	Lesson 8: Magnetism Is a Force	PDF pages 25–30	AP 8.1, AP 8.2
☐	Lesson 9: Solving Problems with Magnets	PDF pages 31–36	AP 9.1
☐	Lesson 10: Forces and Trains	PDF pages 37–42	—
☐	Unit review and assessment	—	AP UR.1
☐	Words quiz	—	—

Page numbers are the PDF page numbers of the Student Reader file, so they match what your PDF reader shows.

Lesson 1: Pushes, Pulls, and Motion

THE BIG QUESTION

What is force?

Words to know

- **force** — a push or a pull
- **motion** — the process of an object changing position
- **direction** — a path along which something moves
- **pull** — the application of a force with the intent to move something toward the source of the force
- **push** — the application of a force with the intent to move something away from the source of the force
- **speed** — the rate at which something moves
- **strength** — the amount of force applied to an object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 23–27: the steps, materials and timing for this lesson.

Talk it over

1. What happens to an object when you give it a push?
2. What happens when you give it a pull?
3. What could be pushing or pulling on those sailing stones in Death Valley?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is force?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 1.1: Push It, Pull It — Teacher Guide PDF page 92

Lesson 2: A Force Is a Push or a Pull

THE BIG QUESTION

What are balanced and unbalanced forces?

Words to know

- **force** — a push or a pull
- **motion** — the process of an object changing position
- **balanced forces** — a collection of forces acting on an object that cancel each other out and produce no change in the object's motion
- **unbalanced forces** — a collection of forces acting on an object that result in a change in the object's motion
- **gravity** — a force that pulls objects toward Earth's surface
- **at rest** — not moving
- **direction** — a path along which something moves
- **speed** — the rate at which something moves
- **strength** — the amount of force applied to an object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 28–33: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 1: “A Force Is a Push or a Pull”: PDF pages 7–12. Look at the pictures and maps together.

Talk it over

1. What causes an object to experience unbalanced forces?
2. What is the effect on an object that experiences unbalanced forces?
3. What is a force?
4. What kind of forces are acting on or around you right now?
5. What is the relationship between the force on an object and its motion?
6. Why does a ball sitting on the ground not move on its own?
7. What is gravity?
8. What evidence shows that gravity is a force acting upon everything on Earth?
9. What is a way to show that a force has direction?
10. What is a way to show that a force has strength?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are balanced and unbalanced forces?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 2.1: Check — Teacher Guide PDF page 93

Lesson 3: Investigating Forces

THE BIG QUESTION

How do forces affect the motion of objects?

Words to know

- **balanced forces** — a collection of forces acting on an object that cancel each other out and produce no change in the object's motion
- **unbalanced forces** — a collection of forces acting on an object that result in a change in the object's motion
- **predict** — to say that something is expected to happen
- **pattern** — something that keeps repeating

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 34–39: the steps, materials and timing for this lesson.

Talk it over

1. What direction did an object move when pushed?
2. Did the object move in the same direction when it was pulled?
3. What happened when two or more equal forces were applied in opposite directions?
4. What different kinds of motion happened when multiple forces were applied in different directions?
5. What is a force?
6. How do balanced forces affect objects that are at rest?
7. How do unbalanced forces affect the speed and direction of objects that are in motion?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do forces affect the motion of objects?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 3.1: Investigating Forces—Plan (Day 1) — Teacher Guide PDF pages 94–95
- Activity Page 3.2: Investigating Forces—Test (Day 2) — Teacher Guide PDF page 96

Lesson 4: Investigating Friction

THE BIG QUESTION

How does the force of friction affect motion?

Words to know

- **friction** — a force that occurs between the surfaces of two objects that are touching
- **contact force** — a push or pull between two objects that are touching each other
- **lubricant** — a substance that reduces friction between objects in contact
- **surface** — the outermost layer of an object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 41–47: the steps, materials and timing for this lesson.

Talk it over

1. How many of you have ever been skiing, ice skating, or sledding?
2. Was it easy to slide on a smooth surface?
3. What happened when you slid on a rougher surface?
4. Was it easy or hard for the block to slide down the ramp? What kind of force did I use to start the block moving?
5. Did the block move fast or slow down this ramp?
6. Did the block go down the ramp easily, or was it hard to go down the ramp?
7. What was changed between the first ramp and the second ramp?
8. What happened to the block this time?
9. Did it go down the ramp more quickly or more slowly?
10. Why do you think the block moved more quickly? What happened to the surface of the ramp?
11. What caused the hockey puck to get stuck in the pan?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How does the force of friction affect motion?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 4.1: Table Hockey — Teacher Guide PDF pages 97–98

Lesson 5: Friction Is a Force

THE BIG QUESTION

What are the characteristics of the force called friction?

Words to know

- **friction** — a force that occurs between the surfaces of two objects that are touching
- **oppose** — to work against
- **contact force** — a push or pull between two objects that are touching each other
- **lubricant** — a substance that reduces friction between objects in contact
- **surface** — the outermost layer of an object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 48–53: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 2: “Friction Is a Force”: PDF pages 13–18. Look at the pictures and maps together.

Talk it over

1. What does each surface feel like?
2. How would you describe the speed each object could move across a surface?
3. What pattern do you see from your examples?
4. What surfaces are involved?
5. What movements are opposed by the force of friction?
6. What were some examples of friction from the video?
7. Did you write any examples of friction in the Activity Page that are like the pencil eraser?
8. Did you write any examples of friction in the Activity Page that are like the types of friction discussed in the video?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are the characteristics of the force called friction?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 5.1: Friction Finder — Teacher Guide PDF page 99
- Activity Page 5.2: Check — Teacher Guide PDF page 100

Lesson 6: Predicting Patterns of Motion

THE BIG QUESTION

Can we predict the motion of an object that moves in regular patterns?

Words to know

- **force** — a push or a pull
- **motion** — the process of an object changing position
- **predict** — to say that something is expected to happen
- **pattern** — something that keeps repeating
- **direction** — a path along which something moves
- **pull** — the application of a force with the intent to move something toward the source of the force
- **push** — the application of a force with the intent to move something away from the source of the force

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 55–61: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 3: “Predicting Patterns of Motion”: PDF pages 19–24. Look at the pictures and maps together.

Talk it over

1. What patterns do you see?
2. Can you make a prediction about what will happen if I let the yo-yo unwind?
3. What forces are involved in this movement?
4. What happens to objects that experience a push force?
5. What happens to objects that experience a pull force?
6. How does this provide evidence for patterns of motion?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Can we predict the motion of an object that moves in regular patterns?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 6.1: Forces and Patterns — Teacher Guide PDF pages 101–102

Lesson 7: Investigating Magnets

THE BIG QUESTION

How do magnets interact with different materials and each other?

Words to know

- **magnet** — a material that applies the force of magnetism
- **magnetism** — a force that can push or pull on some materials without touching them
- **attract** — to pull something closer
- **magnetic poles** — the places on a magnet where the magnetic force is strongest
- **repel** — to push away from
- **distance** — the space between two or more things
- **orientation** — the position of one object in relation to another object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 63–69: the steps, materials and timing for this lesson.

Talk it over

1. Have you seen or used a magnet?
2. Do you know of or use magnets in your home or in the classroom?
3. Have you ever wondered how a magnet works?
4. Reset the demonstration with the paper clips, and start the demonstration over, this time holding the magnet farther away from the paper clips. Ask students what they observed: What happened to the paper clips this time?
5. Do you think this pencil will be pulled to the magnet? What if I move the magnet closer to the pencil?
6. What do you think will happen to these pushpins when I put the magnet over them? How about when I move the magnet far away?
7. What makes something be attracted to a magnet?
8. What did the objects that were attracted to the magnet have in common?
9. Were the objects attracted to the magnet shiny?
10. Were they all a kind of metal?
11. What force caused the metal paper clips (or other metal objects) to move toward the magnet?
12. What was the result, or effect, of magnetism?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do magnets interact with different materials and each other?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 7.1: Fishing with Magnets — Teacher Guide PDF pages 103–104

Lesson 8: Magnetism Is a Force

THE BIG QUESTION

What are the characteristics of the force called magnetism?

Words to know

- **magnet** — a material that applies the force of magnetism
- **magnetism** — a force that can push or pull on some materials without touching them
- **attract** — to pull something closer
- **magnetic poles** — the places on a magnet where the magnetic force is strongest
- **repel** — to push away from
- **distance** — the space between two or more things
- **orientation** — the position of one object in relation to another object

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 70–75: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 4: “Magnetism Is a Force”: PDF pages 25–30. Look at the pictures and maps together.

Talk it over

1. Why does the metal ball move?
2. What is being pushed or pulled in this activity?
3. Does this support the idea that magnetism is a force?
4. Is the magnetic force visible?
5. Does magnetic force increase or decrease with distance?
6. What makes two magnets attract?
7. What makes two magnets repel?
8. How do you know when something is or is not magnetic?
9. When do two magnets attract each other? When do they repel each other?
10. How would different poles of a magnet attract or repel a piece of iron that is not a magnet?
11. How do you know magnetism is a force?
12. What is the relationship between magnetic strength and distance?
13. What is a way you have used magnets?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are the characteristics of the force called magnetism?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 8.1: Check — Teacher Guide PDF page 105
- Activity Page 8.2: Core Vocabulary Review — Teacher Guide PDF page 106

Lesson 9: Solving Problems with Magnets

THE BIG QUESTION

What problems can be solved with magnets?

Words to know

- **magnetism** — a force that can push or pull on some materials without touching them
- **attract** — to pull something closer
- **magnetic poles** — the places on a magnet where the magnetic force is strongest
- **repel** — to push away from
- **problem** — a want or need that requires a solution
- **solution** — a plan or object that solves a problem
- **distance** — the space between two or more things
- **engineering design** — the process by which solutions to a problem are developed

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 76–83: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 5: “Solving Problems with Magnets”: PDF pages 31–36. Look at the pictures and maps together.

Talk it over

1. If the needle of the compass is a magnet, what do you think it is made of?
2. When the needle spins around, is it being pushed away from Earth's north magnetic pole or pulled toward Earth's north magnetic pole?
3. The compass needle orients to a north-south position. What do you think would happen if you face south?
4. What is the problem that I needed to solve?
5. What was the solution that I used?
6. What is the problem that you see?
7. What do you think would happen if the crane held the magnet up higher?
8. What makes the objects in the junkyard attracted to the magnet?
9. Why does this thing work the way that it does?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What problems can be solved with magnets?

- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 9.1: Problem and Solution — Teacher Guide PDF pages 107–108

Lesson 10: Forces and Trains

THE BIG QUESTION

How have engineering designers improved trains?

Words to know

- **force** — a push or a pull
- **motion** — the process of an object changing position
- **balanced forces** — a collection of forces acting on an object that cancel each other out and produce no change in the object's motion
- **unbalanced forces** — a collection of forces acting on an object that result in a change in the object's motion
- **gravity** — a force that pulls objects toward Earth's surface
- **friction** — a force that occurs between the surfaces of two objects that are touching
- **oppose** — to work against
- **contact force** — a push or pull between two objects that are touching each other
- **lubricant** — a substance that reduces friction between objects in contact
- **predict** — to say that something is expected to happen
- **pattern** — something that keeps repeating
- **magnet** — a material that applies the force of magnetism
- **magnetism** — a force that can push or pull on some materials without touching them
- **attract** — to pull something closer
- **magnetic poles** — the places on a magnet where the magnetic force is strongest
- **repel** — to push away from
- **problem** — a want or need that requires a solution
- **solution** — a plan or object that solves a problem

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 84–90: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 6: "Forces and Trains": PDF pages 37–42. Look at the pictures and maps together.

Talk it over

1. What evidence tells you what kind of person Elijah McCoy was?
2. What is an engineer? What is an engineering designer?
3. How can you predict the motion of a train?

4. What problems must be overcome to start the movement of a heavy train?
5. What types of solutions to the problems have engineers developed?
6. How did Elijah McCoy's invention improve train travel?
7. Why do you think McCoy may have gotten a patent?
8. What are the advantages of maglev trains over other trains?
9. How do maglev trains work?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How have engineering designers improved trains?
- Use one of today's words in a sentence of your own.

UNIT REVIEW

Unit review and assessment

- Unit Assessment (print for your student): Teacher Guide PDF pages 110–113
- How to mark it (for the teacher): Teacher Guide PDF pages 116–119
- Activity page answer key (for the teacher): Teacher Guide PDF pages 114–115
- Activity Page UR.1: Big Questions About Forces — Teacher Guide PDF page 109

WORDS QUIZ

Investigating Forces

Name: _____ Date: _____

Circle the letter of the best answer.

- 1.** Which word means “a force that can push or pull on some materials without touching them”?
 - a) repel
 - b) pattern
 - c) contact force
 - d) magnetism
- 2.** Which word means “a collection of forces acting on an object that result in a change in the object’s motion”?
 - a) magnetism
 - b) unbalanced forces
 - c) pattern
 - d) balanced forces
- 3.** Which word means “the places on a magnet where the magnetic force is strongest”?
 - a) predict
 - b) contact force
 - c) balanced forces
 - d) magnetic poles
- 4.** Which word means “to pull something closer”?
 - a) predict
 - b) attract
 - c) friction
 - d) oppose
- 5.** Which word means “to say that something is expected to happen”?
 - a) solution
 - b) contact force
 - c) predict
 - d) unbalanced forces
- 6.** Which word means “a push or pull between two objects that are touching each other”?
 - a) magnetic poles
 - b) contact force
 - c) balanced forces
 - d) motion

- 7.** Which word means “a want or need that requires a solution”?
- a) motion
 - b) balanced forces
 - c) problem
 - d) lubricant
- 8.** Which word means “a plan or object that solves a problem”?
- a) force
 - b) magnetic poles
 - c) problem
 - d) solution
- 9.** Which word means “a force that occurs between the surfaces of two objects that are touching”?
- a) magnetism
 - b) balanced forces
 - c) friction
 - d) predict
- 10.** Which word means “the process of an object changing position”?
- a) attract
 - b) motion
 - c) magnetism
 - d) magnet
- 11.** Which word means “a material that applies the force of magnetism”?
- a) magnet
 - b) gravity
 - c) contact force
 - d) lubricant
- 12.** Which word means “a force that pulls objects toward Earth’s surface”?
- a) gravity
 - b) solution
 - c) lubricant
 - d) problem

Answers

Lesson 1: Pushes, Pulls, and Motion

1. **What happens to an object when you give it a push?**
A push makes an object move away.
2. **What happens when you give it a pull?**
A pull makes an object move closer or follow the direction of the pull.
3. **What could be pushing or pulling on those sailing stones in Death Valley?**
Weather, such as wind, water, and ice, may make these rocks move.

Lesson 2: A Force Is a Push or a Pull

1. **What causes an object to experience unbalanced forces?**
One force is stronger than another force.
2. **What is the effect on an object that experiences unbalanced forces?**
It will move in the direction of the strongest force.
3. **What is a force?**
A push or a pull
4. **What kind of forces are acting on or around you right now?**
Gravity, pushes, and pulls
5. **What is the relationship between the force on an object and its motion?**
A force causes a change, so the object is moved by the force.
6. **Why does a ball sitting on the ground not move on its own?**
A ball that is on flat ground will not move unless a force greater than gravity is applied.
7. **What is gravity?**
Gravity is a force that pulls everything to Earth.
8. **What evidence shows that gravity is a force acting upon everything on Earth?**
When an object is dropped, it always falls downward.
9. **What is a way to show that a force has direction?**
An object reacts to a push or a pull by moving away from or toward the force. The direction of gravity is a force that pulls all objects down.
10. **What is a way to show that a force has strength?**
When a ball is thrown with a lot of strength, it moves faster than a ball that is gently tossed.

Lesson 3: Investigating Forces

1. **What direction did an object move when pushed?**
An object moves in the direction that it was pushed, away from the push.

2. **Did the object move in the same direction when it was pulled?**
No, a pull moves an object closer rather than away.
3. **What happened when two or more equal forces were applied in opposite directions?**
The object does not move if the push and pull forces are the same.
4. **What different kinds of motion happened when multiple forces were applied in different directions?**
The direction of motion changes with each bump or when a stronger force cancels out a lighter force.
5. **What is a force?**
A force is a push or a pull.
6. **How do balanced forces affect objects that are at rest?**
There is no movement of the object, so it stays at rest.
7. **How do unbalanced forces affect the speed and direction of objects that are in motion?**
Objects in motion go faster or farther in the same direction as the stronger force.

Lesson 4: Investigating Friction

1. **How many of you have ever been skiing, ice skating, or sledding?**
Students may raise their hands or tell their stories.
2. **Was it easy to slide on a smooth surface?**
A smooth surface makes sliding easier.
3. **What happened when you slid on a rougher surface?**
It was harder to slide.
4. **Was it easy or hard for the block to slide down the ramp? What kind of force did I use to start the block moving?**
A push started the block moving, but gravity kept it going down the ramp.
5. **Did the block move fast or slow down this ramp?**
The block moved slowly on the sandpaper.
6. **Did the block go down the ramp easily, or was it hard to go down the ramp?**
It did not move as easily as it did on the first ramp.
7. **What was changed between the first ramp and the second ramp?**
One is a smooth surface, but the other is a rough surface.
8. **What happened to the block this time?**
It moved farther.
9. **Did it go down the ramp more quickly or more slowly?**
More quickly
10. **Why do you think the block moved more quickly? What happened to the surface of the ramp?**
The block moved faster because the ramp was oily.

11. What caused the hockey puck to get stuck in the pan?

What was the result of adding oil into the pan?

Lesson 5: Friction Is a Force

1. What does each surface feel like?

Some are smooth, and some are rough.

2. How would you describe the speed each object could move across a surface?

Objects that move slow are on rough surfaces, and objects that move fast are on smooth surfaces.

3. What pattern do you see from your examples?

Smooth surfaces result in less friction, and rougher surfaces result in more friction.

4. What surfaces are involved?

The paper has a smooth surface, and the eraser has a surface that slightly comes apart when it is rubbed.

5. What movements are opposed by the force of friction?

It's hard to keep the paper flat when rubbing the eraser back and forth.

6. What were some examples of friction from the video?

What surfaces are involved?

7. Did you write any examples of friction in the Activity Page that are like the pencil eraser?

How are these examples similar?

8. Did you write any examples of friction in the Activity Page that are like the types of friction discussed in the video?

How are these examples similar? Now that students have read Chapter 2 about friction, return to the video and the claim that "When a student sits at rest (still) on a slide, friction is not acting on this student because she is not moving."

Lesson 6: Predicting Patterns of Motion

1. What patterns do you see?

The yo-yo moves downward from gravity, but it will not move all the way back up without a tug. As it repeats, the distance back up is shorter and shorter.

2. Can you make a prediction about what will happen if I let the yo-yo unwind?

The yo-yo will stop.

3. What forces are involved in this movement?

Gravity pulls down and a tug from the hand pulls up.

4. What happens to objects that experience a push force?

They move away from the push force.

5. What happens to objects that experience a pull force?

They move toward the pull force.

6. How does this provide evidence for patterns of motion?

Objects that are pushed or pulled by unbalanced forces will have motion forward or

backward.

Lesson 7: Investigating Magnets

1. Have you seen or used a magnet?

Most students will answer yes.

2. Do you know of or use magnets in your home or in the classroom?

Magnets are commonly used on cabinet doors and to attach paper and pictures to a refrigerator.

3. Have you ever wondered how a magnet works?

I know that some objects stick to it and some don't.

4. Reset the demonstration with the paper clips, and start the demonstration over, this time holding the magnet farther away from the paper clips. Ask students what they observed: What happened to the paper clips this time?

They did not move.

5. Do you think this pencil will be pulled to the magnet? What if I move the magnet closer to the pencil?

The pencil will not move unless it has some metal on it that the magnet attracts.

6. What do you think will happen to these pushpins when I put the magnet over them? How about when I move the magnet far away?

The metal part of each pushpin may turn toward the magnet. Moving the magnet farther away will not attract the pins.

7. What makes something be attracted to a magnet?

Certain metals are attracted to magnets, such as iron and nickel.

8. What did the objects that were attracted to the magnet have in common?

They had some form of metal on them.

9. Were the objects attracted to the magnet shiny?

Some were shiny, and some had plastic on part, such as the pushpins.

10. Were they all a kind of metal?

Yes

11. What force caused the metal paper clips (or other metal objects) to move toward the magnet?

Magnetic force

12. What was the result, or effect, of magnetism?

Magnetism affects objects that have certain contents that are attracted to magnets.

Lesson 8: Magnetism Is a Force

1. Why does the metal ball move?

The magnetic attraction works through the cardboard.

2. What is being pushed or pulled in this activity?

The magnet is pushed or pulled, and its magnetic force pushes or pulls the ball.

3. Does this support the idea that magnetism is a force?

Yes

4. **Is the magnetic force visible?**
Magnetic force is invisible.
5. **Does magnetic force increase or decrease with distance?**
Magnetic force decreases with distance.
6. **What makes two magnets attract?**
Opposite ends pull together.
7. **What makes two magnets repel?**
The same type of ends, such as north and north, push apart from each other.
8. **How do you know when something is or is not magnetic?**
If something is not attracted to a magnet, the object is not magnetic.
9. **When do two magnets attract each other? When do they repel each other?**
Opposite poles attract each other, but like poles repel.
10. **How would different poles of a magnet attract or repel a piece of iron that is not a magnet?**
Either pole would attract a piece of iron that is magnetic but not a magnet.
11. **How do you know magnetism is a force?**
You cannot see it, but you can see the result of it working.
12. **What is the relationship between magnetic strength and distance?**
The strength of the pull decreases as the distance increases.
13. **What is a way you have used magnets?**
I use magnets to hold notes on a refrigerator and to make sure a cabinet door stays closed.

Lesson 9: Solving Problems with Magnets

1. **If the needle of the compass is a magnet, what do you think it is made of?**
Iron, metal
2. **When the needle spins around, is it being pushed away from Earth's north magnetic pole or pulled toward Earth's north magnetic pole?**
One end is being pulled, and the other is pushed.
3. **The compass needle orients to a north-south position. What do you think would happen if you face south?**
You face a different direction, but the compass needle still points north.
4. **What is the problem that I needed to solve?**
I want to display the paper on a board.
5. **What was the solution that I used?**
I used a magnet to hold the paper on a magnetic board.
6. **What is the problem that you see?**
The door won't stay shut.
7. **What do you think would happen if the crane held the magnet up higher?**
It may not pick up anything.

8. **What makes the objects in the junkyard attracted to the magnet?**

They contain metals that are attracted to magnets.

9. **Why does this thing work the way that it does?**

How can I make this thing work even better?

Lesson 10: Forces and Trains

1. **What evidence tells you what kind of person Elijah McCoy was?**

He was trained to be an engineer, worked where he could find work, and was a problem solver.

2. **What is an engineer? What is an engineering designer?**

An engineer designs or builds machines or parts to create or improve ways to make work easier.

3. **How can you predict the motion of a train?**

A train moves forward or backward on a track.

4. **What problems must be overcome to start the movement of a heavy train?**

The obstacles to moving a train are the weight of the train, its position, gravity, and friction.

5. **What types of solutions to the problems have engineers developed?**

Some solutions include using various fuels, improving the wheels, reducing friction, and using lighter materials to build the train.

6. **How did Elijah McCoy's invention improve train travel?**

McCoy's way of lubricating the engine meant that the train could make fewer stops.

7. **Why do you think McCoy may have gotten a patent?**

A patent kept others from making money off of his invention.

8. **What are the advantages of maglev trains over other trains?**

Maglev trains use magnets instead of wheels, so friction is reduced, making train rides quiet and smooth.

9. **How do maglev trains work?**

Magnets are used to levitate, or float, the trains over the tracks.

Unit quiz key

1. d 2. b 3. d 4. b 5. c 6. b 7. c 8. d 9. c 10. b 11. a 12. a